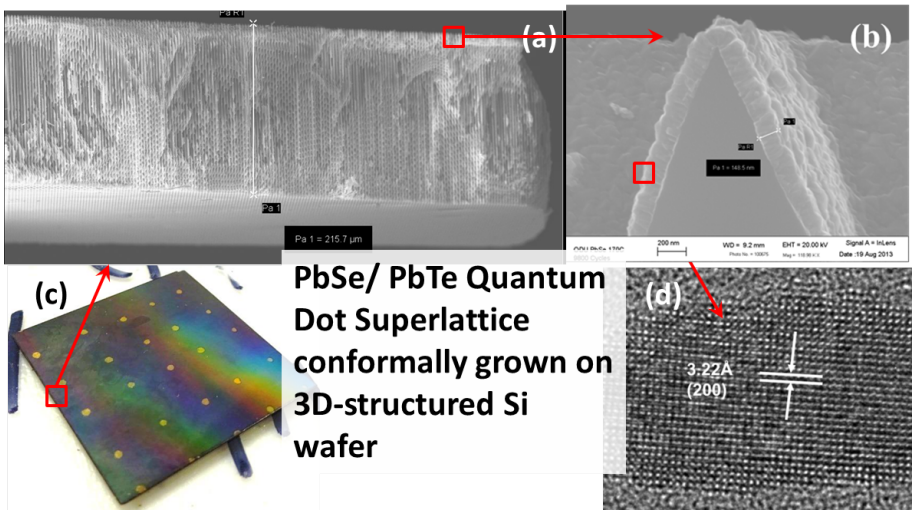
NASA SBIR/STTR Technologies

T3.01-9890 - High figure-of-merit macro-structured thermoelectric materials

PI: Vladimir Kochergin
MicroXact, Inc. - BLACKSBURG, VA

Identification and Significance of Innovation

New high conversion efficiency TE devices, as well the manufacturing methods need to be developed to meet the growing NASA, DoD and commercial needs in thermoelectric energy. The team of MicroXact Inc. and Virginia Tech is proposing to develop a revolutionary high efficiency thermoelectric material fabricated on completely new fabrication principles. The material is comprised of three-dimensional "wells" of PbTe/PbSe superlattices fabricated by a conformal coating of structured silicon wafers. Such a material will provide a ZT>1.6 at macroscopic thicknesses, permitting 15% or more conversion efficiencies in the 400K-600K temperature range.



Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)

Technical Objectives and Work Plan

Technical Objectives:
1. Develop a fabrication process at which the oxidation of the interface between the PbTe/PbSe QDs and electrode material is eliminated.
2. Demonstrate a thermoelectric material with thicknesses in at least the 10s of mm range with ZT>1.6.
3. Develop strategies for product commercialization and transition to manufacturing.

Work Plan:
Task 1. Fabricate MPSi templates.
Task 2. Develop and optimize PbTe/PbSe QDS and electrode deposition.
Task 3. Perform electrical conductivity and Seebeck effect characterization.
Task 4. Identify the thermal conductivity of the developed material.
Task 5. Develop the design of a thermoelectric power generator.
Task 6. Enhance the commercialization strategy.

NASA Applications

Power generation on board of spacecraft (NASA).
Cooling of electronic components (NASA, DoD, commercial).
Waste heat recovery (NASA, DoD, commercial).

Non-NASA Applications

Cooling of electronic components (NASA, DoD, commercial).
Waste heat recovery (NASA, DoD, commercial).
Residential cooling and refrigeration (commercial).
Industrial Waste Heat, Arc Furnaces, Smelting Cells, etc. (commercial)
Premium Portable Power (DoD, commercial)
Waste Heat, Geothermal Power Plants (DoE, commercial).

Firm Contacts

Elena Kochergina
MicroXact, Inc.
1750 Kraft Drive, Suite 1007
BLACKSBURG, VA, 24060-6375
PHONE: (540) 394-4040
FAX: (866) 588-0908